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IDENTIFICATION OF PENCIL-USING SKILLS OF CHILDREN AGED 36-66 MONTHS

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ABSTRACT

The aim of the current study is to identify pencil-using skills of the children aged 36-66 months. The sample of the study was consisted of 600 children who were attended preschool institutions. As data collection tools; "Observation form for pencil-using skills", "goniometer" to identify positions of paper, sitting, shoulder, elbow, arm and wrist and "hand dynamometer" and "finger dynamometer" to measure hand-grip strength and compressive strength of fingers were used. Pencil-using skills were assessed under the titles of hand-preference, positions of paper, sitting, shoulder, elbow, arm and wrist, pencil-using skills and pencil-grip point, the number of the pencil-gripping fingers, position of thumb and flexion angle of index finger. According to the research findings; hand-preference, positions of paper, sitting, shoulder, elbow, arm and wrist, pencil-using skills and pencil-grip point, the number of the pencil-gripping fingers did not differ significantly in terms of gender whereas position of thumb and flexion angle of index finger was significantly different on behalf of girls. Positions of paper, sitting, shoulder, elbow, arm and wrist, pencil-using skills and pencil-grip point, position of thumb and flexion angle of index finger did not differ significantly in terms of age whereas the number of the pencil-gripping fingers was significantly different on behalf of children aged 49-60 months. Hand-grip strength and compressive strength of fingers of the children differed significantly on behalf of boys in terms of gender and those aged 61-66 months in terms of age.

KEYWORDS: Hand-grip strength, compressive strength of fingers, age, gender, early childhood.

INTRODUCTION:

Early childhood period includes experiences of pencil using and writing for the first time. During early childhood period; it is very important to provide correct information on pencil-grip. Incorrect pencil-grip causes tiredness of hands quickly and withdrawal from exercises that require pencil-using (Polat, 2010b). Thus; improvement of fast and elaborate hand-writing skills that children acquire during primary school period is slowed down (Temur, 2011). Incorrect pencil-grip experiences may continue lifelong.

First education on pencil-grip is given by parents during preschool period. That children start to pay attention to writing movements and move pencil as if they could write is an indication that they are ready to use pencil (Nutbrown, 1994). In the first step; it is necessary to demonstrate children correct pencil-grip patterns and to help the children to place their fingers on pencils. It should be demonstrated how pencils are grasped and moved. Providing feedbacks to children about their pencil-grip and providing corrections if necessary facilitate learning correct pencil-grip patterns (Polat, 2010a). Pencil-grip is epidemically categorized to the position of the thump, the number of fingers putting on the pencil and finger joint positions (Schwellnus, 2013). It is necessary to encourage children about correct pencil-using skills and to provide supportive learning environment that will facilitate their pencil-using efforts (Kılıçgün Yurtsever and Kılıçkaya, 2015). Although pencil-grip is a very important factor for writing, it is almost impossible to argue that a standard training is given to children so that they can hold and grip pencil correctly and use correct fingers. Rather; it is more reasonable to argue that children generally develop a more comfortable grip pattern on their own (Temur, Aksoy and Tabak, 2011). This pencil-grip pattern may be correct or incorrect. Koziatek and Powell (2003), Dennis and Swinth (2001), Tseng (1998), Tseng and Hsueh (1997) and Ziviani and Elkins (1986) suggest that different pencil-grip patterns are possible. Temur, Aksoy and Tabak (2011) observe that first grade primary school children mostly hold pencil with thumbs and index fingers.

Greer and Lockman (1998) and Tseng (1998) identified pencil-grip patterns that may be observed during early childhood period. However; it is noted that pencil-using among the preschool children is not discussed in terms of such variables as age, gender, finger strength and grip strength. Although such educational attainments as "correct pencil-holding" and "managing pencil control" are taught to children aged 36-72 months in the preschool education program designed by the National Education Ministry (2013); there are the limited number of studies on readiness for reading and writing and pencil-using skills. These studies do not examine pencil-using skills in detail and generally discuss preparatory works for reading and writing provided to 6 year old children (Alisinanoğlu and Şimşek, 2012; Bay, Altun and Çetin, 2014; Duran, 2013; Polat Unutkan, 2003; Yangın, 2007).

In the current study; the aim was to discover pencil-using skills of the children aged 36-66 months. Pencil using skills among this age group were assessed under the titles of hand-preference, positions of paper, sitting, shoulder, elbow and wrist, pencil-using skills and pencil-grip point, position of thumb and flexion angle of index finger and hand-grip strength and compressive strength.

METHOD:

Research design:

The aim of the current study was to identify pencil-using skills of the children aged 36-66 months. Qualitative and quantitative data were cross-sectional collected in order to find out pencil-using skills. Therefore; the study was designed in descriptive model (Christensen, Johnson, & Turner, 2015).

Ethics:

Turkey Erzincan Province National Education Directorate Ethical Review Committee (Protocol ID NO: 45468433/605/858793) gave ethical approval for this study. In addition, information about the research was given to the participants.

Research sample:

The population of the current study was composed of children aged 36-66 months who attended preschool institutions located in Erzincan Province. Sample of the study was determined using random sampling method (Arıcı, 1998). A total of 600 children were recruited for the study sample [292 girls (48.7%) and 308 boys (51.3%)]. 169 children were aged 36-48 months (12%), 245 children were aged 49-60 months (16.2%) and 186 children were aged 61-66 months (18.3%). Mean hand-grip strength of the children was 11.72±5.13 kg and mean compressive strength of fingers was 2.10±1.04 kg.

Research instrument and procedure:

As data collection tools; "Observation form for pencil-using skills", "goniometer" which was used to identify positions of paper, sitting, shoulder, elbow, arm and wrist when children used pencils and "hand dynamometer" and "finger dynamometer" to measure hand-grip strength and of fingers were used.

The study was undertaken in a quiet place at the preschool institutions isolated from noisy and distracting interventions with height-appropriate chairs and study-tables for these children. The children were individually assessed. During the study-interventions; the author demonstrated pictures in order where vertical, horizontal, curved and bend lines were drawn. The children were asked to draw these lines on a paper using pencil. During the drawings; white paper (210 x 297 mm) and Lyra Groove triangular pencils (10 mm) were used. With "goniometer"; children's positions of paper, sitting, shoulder, elbow, arm and wrist were established during drawings. With "hand dynamometer" and "finger dynamometer"; hand-grip strength and compressive strength of fingers were measured. While the children were drawing; observations about the children's pencil-using skills and values found in the measurements of hand-grip strength and compressive strength of fingers were written down observation form for pencil-using skills.

Observation form for pencil-using skills. The form was developed within the context of the current study. The validity of the form was established with Lawshe technique (Yurdugül 2005) and opinions of five experts. Minimum content validity values of each parameter of the form were .99.

Pencil using skills of the children were evaluated under the titles of hand-preference, positions of paper, sitting, shoulder, elbow, arm and wrist, pencil-using skills and pencil-grip point, the number of the pencil-gripping fingers, posi-

tion of thumb and flexion angle of index finger. Details about these titles are as follows:

- Hand preference: right hand, left hand and undecided.
- Paper position: right 15º, right 30º, right 45º, right 60º, vertical, horizontal, left 15º, left 30º, left 45º, left 60º and undecided.
- Sitting position: leaning forward, leaning backward, upright and standing-up.
- Pencil-grip postures: palmar-grip with thumb facing downward, palmar-grip with thumb facing upward, half-fisted-grip with thumb and index finger, narrow grip with flexed thumb and flexed index finger, grip by pinching thumb and index finger, grip in a brush holding position, vertical tripod grip with extended fingers, four finger grip, grip with flexed thumb, middle and index fingers and dynamic tripod grip (mobile grip with thumb, middle and index fingers).
- Wrist position: angled, vertical and parallel.
- Shoulder-elbow-arm position: correct and incorrect.
- Pencil-grip point: lower parts, middle parts (standard), upper parts, backward and undecided.
- Number of the fingers grasping pencil: two fingers- thumb and index finger, two fingers –thumb and middle finger, three fingers- thumb, index and middle fingers, four fingers and five fingers/palmar.
- Thumb position: thumb on pencil and pointing index finger.
- Flexion angle of index finger: smaller than 45º, more than 90º, 90 º, parallel and undecided.

Data analysis:
The descriptive data of the study were analyzed with percentages (%) and frequencies (f). Chi-square analyses were used in order to understand whether or not pencil-using skills changed significantly in terms of age and gender variables. T-test (independent samples) and One-way analysis of variance (ANOVA) were used in order to find out whether or not pencil-using skills differed significantly in terms of hand-grip strength and compressive strength.

FINDINGS:
Findings obtained from the study were demonstrated in four tables below. Table 1 demonstrated results of chi-square analyses between gender variable and pencil-using skill parameters, Table 2 demonstrated results of chi-square analyses between age variable and pencil-using skill parameters, Table 3 demonstrated t-test (independent samples) results between pencil-using skill parameters and hand-grip strength and compressive strength of fingers in terms of gender variable and Table 4 demonstrated ANOVA results between pencil-using skill parameters and hand-grip strength and compressive strength of fingers in terms of age variable.

Table 1: Results of chi-square analyses made between gender variable and pencil-using skill parameters

When the findings in Table 1 were examined; there were not any statistically significant differences between hand preference, paper position, sitting position, pencil-grip position, wrist position, shoulder-elbow-arm positions, pencil-grip point and the number of the pencil-gripping fingers. However; it was found out that there were significant differences in terms of thumb position (X^2=9.09, p<.00) and flexion angle of index finger (X^2=23.56, p<.00) on behalf of girls.

Table 2: Results of chi-square analyses made between age variable and pencil-using skill parameters

When the findings in Table 2 were examined; there were not any statistically significant differences between hand preference, paper position, sitting position, pencil-grip position, wrist position, pencil-grip point, thumb position and flexion angle of index finger in terms of age variable. Yet; it was noted that there were significant differences in terms of shoulder-elbow-arm positions on behalf of those aged 61-66 months (X^2=43.11, p<.00) and in terms of the number of the pencil-gripping fingers on behalf of those aged 49-60 months (X^2=29.58, p<.00).

Table 3: Results of t-test (independent samples) made between pencil-using skill parameters and hand-grip strength and compressive strength of fingers in terms of gender variable

When the findings in Table 3 were examined; it was seen that hand-grip strength (t=-5.22, p<.00) and compressive strength of fingers (t=-4.21, p<.00) differed significantly on behalf of boys.

Table 4: ANOVA results between pencil-using skill parameters and hand-grip strength and compressive strength of fingers in terms of age variable

When the findings in Table 4 were examined; it was noted that hand-grip strength (F=18.77, p<.00) and compressive strength of fingers (F=5.47, p<.00) differed significantly on behalf of those aged 61-66 months and as age of the children increased so did their hand-grip strength and compressive strength of fingers.

DİSCUSSİON, CONCLUSİON AND RECOMMENDATİONS:
DISCUSSION:
Pencil-using skills of the participant children aged 36-66 months were assessed under the titles of hand-preference, positions of paper, sitting, shoulder, elbow, arm and wrist, pencil-using skills and pencil-grip point, the number of the pencil-gripping fingers, position of thumb and flexion angle of index finger.

According to the findings of the study; hand-preference, positions of paper, sitting, shoulder, elbow, arm and wrist, pencil-using skills and pencil-grip point, the number of the pencil-gripping fingers did not show significant differences in terms of gender variable while position of thumb and flexion angle of index finger differed significantly on behalf of girls. Positions of paper, sitting, wrist, pencil-using skills and pencil-grip point, position of thumb and flexion angle of index finger did not differ significantly in terms of age whereas positions of shoulder, elbow and arm differed significantly on behalf of children aged 61-66 months. The number of the hand-gripping finger was significantly different on behalf of children aged 49-60 months. Hand-grip strength and compressive strength of fingers of the children differed significantly on behalf of boys in terms of gender and those aged 61-66 months in terms of age. It was also identified that as age of the children increased so did their hand-grip strength and compressive strength.

We know that hand preference becomes established during preschool period. In the society; prevalence of right handedness is by 85-90% (Johnston, Shah and Shields, 2007; Mehrotra and Sinha, 2012; Yıldız and Öztürk, 2013). According to the study findings; it is seen that children aged 36-66 months used right hands most (Table 1 and Table 2). Gender and age did not produce a significant difference in terms of hand preference (Table 3 and Table 4); which concurred with the findings in the literature.

One of the most critical considerations in writing is sitting position. The most important cause of the back pain, lower back pain and neck pain is wrong sitting positions (Smith-Zuzovsky and Exner, 2004; Lafond, Descarreaux, Normand and Harrison, 2007). As emphasized by Akyol (2007), wrong sitting position affects writing speed and readability of handwriting negatively. According to Croutch (1976), Troussier (2010) and Marschall, Harrington and Steele (2007); posture and muscle development are affected by many factors such as structure of sitting set (furniture), paper position, pencil-gripping hand. According to the study-findings; it was noted that the children aged 36-66 months sat upright in chairs and adjusted their bodies according to the position of the table. This finding could be interpreted as an indication that the children in the sample group had a balanced posture and healthy body and spine muscles.

During writing; it is important to adjust and to position notebooks or papers correctly that the children use in writing activities (Ministry of Education, 2008) and the angle between paper and body and writing style (straight or flexed). This angle is nearly 15 degrees for the right handed children and 30 degrees for the left-handed children (Faber Castell, 2015). According to the study findings; it was found out that most of the children aged 36-66 months adjusted and positioned papers on the table platform wrongly.

There are numerous factors that facilitate or complicate writing. One of these factors is to adjust shoulder, elbow and wrist correctly while writing. The arm with which we grasp the pencil should be placed on the paper and positioned parallel to the paper while the other hand should be used to do such activities as moving or holding the paper (Zaner, 1915). According to the study-findings; it was observed that most of the children used correct shoulder, elbow and arm positions on the table platform and there was a significant difference on behalf of those children aged 61-66 months; which pointed out that the children had a balanced posture and gained the correct posture as their ages increased. However; during drawings; it was seen that the children needed to change their wrist positions according to the type of the lines; which demonstrated that they moved pencils through wrist-joints during drawings. Using wrist-joints so frequently made us conclude that they had not developed strong wrist and finger muscles, yet.

In the studies of Amundson (1995), Dennis and Swinth (2001), Koziatek and Powell (2003), Selin (2003), Tseng (1998) and Temur, Aksoy and Tabak (2011); it was reported that children grasped pencils in different styles. These studies generally emphasize that correct pencil-grip pattern is dynamic tripod grip that the ring finger and little finger fixed against writing area (Schwellnus et al., 2012) According to dynamic tripod grip; pencil should be used with thumb, middle finger and index finger and should be held between thumb and index finger with the pencil resting on middle finger. There should be a distance 1.5-2 cm between pencil tip and index finger and thumb should be placed on the pencil. According to the study-findings; it was seen that the children aged 36-66 months grasped pencils by pinching thumb and index finger on pencils and held the pencils backwards.

Although it was found out that the children aged 61-66 months used dynamic tripod grip more often; two-finger grip (thumb and index finger) produced significant difference on behalf of those children aged 49-60 months. Position of thumb and flexion angel of the index finger created difference on behalf of girls. Most of

the children placed thumbs on pencil and index fingers were flexed more than 90º.

When the studies done by Yim, Cho and Lee (2003), Svensson, Waling and Hager-Ross (2008), Surrey et al. (2001) and Lee-Valkov et al. (2003) were investigated; it was argued that hand-grip strength and compressive strength of fingers were higher the boys than girls and muscle strength related to hand-grip and fingers increased with age. As far as the current study was concerned; it was noted that hand-grip strength and compressive strength of fingers differed significantly on behalf of boys in terms of gender and on behalf of those children aged 61-66 months in terms of age. When the values found in the measurements of hand-grip strength and compressive strength of fingers were investigated in terms of age; it was detected that as ages of the children increased so did their hand-grip strength and compressive strength. This finding was in agreement with the literature (Hogrel, 2015; McQuiddy at all, 2015).

CONCLUSION:

In sum up; with the current study pencil-using skills were examined in detail. Such a comprehensive study was -for the first time- done with the children aged 36-66 months in Turkey sample and illuminating information was obtained for the literature.

RECOMMENDATIONS:

All the findings obtained include information that would contribute professional development of preschool and classroom teachers positively and increase quality of intra-classroom activities. Besides; these findings will also be utilized by parents and teachers as a source of information so that children can improve pencil-using skills.

Table 1: Results of chi-square analyses made between gender variable and pencil-using skill parameters

Pencil-Using Skill Parameters		Gender Girl	Boy	Total	X^2	df	p
Hand preference	Right hand	267	274	541	1.36	2	.51
	Left hand	20	25	45			
	Undecided	5	9	14			
Paper position	Right 15º	67	55	122	8.37	10	.59
	Right 30º	13	23	36			
	Right 45º	8	8	16			
	Right 60º	5	5	10			
	Vertical	21	13	34			
	Horizontal	123	133	256			
	Left 15º	25	31	56			
	Left 30º	6	10	16			
	Left 45º	5	6	11			
	Left 60º	5	8	13			
	Undecided	14	16	30			
Sitting position	Leaning forward	40	27	67	10.06	12	.61
	Leaning backward	4	5	9			
	Upright	247	271	518			
	Standing-up	1	5	6			
Pencil-grip postures	Palmar-grip with thumb facing downward	3	6	9	13.67	9	.16
	Palmar-grip with thumb facing upward	5	2	7			
	Half-fisted-grip with thumb and index finger	2	5	7			
	Narrow grip with flexed thumb and flexed index finger	201	209	410			
	Grip by pinching thumb and index finger	11	16	27			
	Grip in a brush holding position	4	7	11			
	Vertical tripod grip with extended fingers	8	5	13			
	Four finger grip	6	8	14			
	Grip with flexed thumb, middle and index fingers	7	18	25			
	Dynamic tripod grip	45	32	77			
Wrist position	Angled	223	231	454	0.59	2	.75
	Vertical	26	25	51			
	Parallel	43	52	95			
Shoulder-elbow-arm position	Correct	145	142	287	0.76	1	.38
	Incorrect	147	166	313			
Pencil-grip point	Lower parts	44	43	87	5.45	4	.24
	Middle parts (standard)	49	40	89			
	Upper parts	76	67	143			
	Backward	119	155	274			
	Undecided	4	3	7			
Number of the fingers grasping pencil	Two fingers-thumb and index finger	216	230	346	2.79	4	.59
	Two fingers-thumb and middle finger	6	8	14			
	Three fingers-thumb, index and middle fingers	55	50	105			
	Four fingers	12	14	26			
	Five fingers/palmar	3	6	9			
Thumb position	Thumb on pencil	213	256	469	9.09	1	.00
	Pointing index finger	79	52	131			
Flexion angle of index finger	Smaller than 45º	79	98	177	23.56	4	.00
	More than 90º	70	59	129			
	90º	126	99	225			
	Parallel	13	40	53			
	Undecided	4	12	16			

N=600

Table 2: Results of chi-square analyses made between age variable and pencil-using skill parameters

Pencil-Using Skill Parameters		Age (month) 36-48	49-60	61-66	Total	X^2	df	p
Hand preference	Right hand	151	224	166	541	8.10	8	.42
	Left hand	12	16	17	45			
	Undecided	6	5	3	14			
Paper position	Right 15º	33	49	40	122	54.98	40	.06
	Right 30º	10	13	13	36			
	Right 45º	4	7	5	16			
	Right 60º	2	6	2	10			
	Vertical	8	19	7	34			
	Horizontal	76	101	79	256			
	Left 15º	18	19	19	56			
	Left 30º	5	9	2	16			
	Left 45º	4	6	1	11			
	Left 60º	4	6	3	13			
	Undecided	5	10	15	30			
Sitting position	Leaning forward	11	30	26	67	10.06	12	.61
	Leaning backward	3	4	2	9			
	Upright	153	209	156	518			
	Standing-up	2	2	2	6			
Pencil-grip postures	Palmar-grip with thumb facing downward	5	3	1	9	42.27	36	.22
	Palmar-grip with thumb facing upward	4	2	1	7			
	Half-fisted-grip with thumb and index finger	3	2	2	7			
	Narrow grip with flexed thumb and flexed index finger	110	178	122	410			
	Grip by pinching thumb and index finger	9	9	9	27			
	Grip in a brush holding position	6	2	3	11			
	Vertical tripod grip with extended fingers	3	6	4	13			
	Four finger grip	4	7	3	14			
	Grip with flexed thumb, middle and index fingers	5	10	10	25			
	Dynamic tripod grip	20	26	31	77			
Wrist position	Angled	144	175	135	454	15.91	8	.44
	Vertical	7	25	19	51			
	Parallel	18	45	32	95			
Shoulder-elbow-arm position	Correct	46	108	133	287	43.11	4	.00
	Incorrect	123	137	53	313			
Pencil-grip point	Lower parts	23	34	30	87	9.76	16	.88
	Middle parts (standard)	22	40	27	89			
	Upper parts	36	59	48	143			
	Backward	86	110	78	274			
	Undecided	2	2	3	7			
Number of the fingers grasping pencil	Two fingers-thumb and index finger	121	205	120	446	29.58	16	.02
	Two fingers-thumb and middle finger	2	9	3	14			
	Three fingers-thumb, index and middle fingers	28	22	55	105			
	Four fingers	12	7	7	26			
	Five fingers/palmar	6	2	1	9			
Thumb position	Thumb on pencil	125	206	138	469	8.74	4	.07
	Pointing index finger	44	39	48	131			
Flexion angle of index finger	Smaller than 45º	52	76	49	177	13.56	16	.63
	More than 90º	34	48	47	129			
	90º	66	89	70	225			
	Parallel	10	29	14	53			
	Undecided	7	3	6	16			

N=600

Table 3: Results of t-test (independent samples) made between pencil-using skill parameters and hand-grip strength and compressive strength of fingers in terms of gender variable

Strength	Gender	N	X	ss	Sh_x	t	Sd	p
Hand-grip strength	Girl	292	10.62	4.65	0.27	-5.22	598	.00
	Boy	308	12.76	5.36	0.30			
Compressive strength of fingers	Girl	292	2.07	1.03	0.12	-4.21	598	.00
	Boy	308	2.13	1.00	0.11			

N=600

Table 4: ANOVA results between pencil-using skill parameters and hand-grip strength and compressive strength of fingers in terms of age variable

Strength	Age	f	X	ss	Variance	KT	sd	KO	F	p
Hand-grip strength	36-42	72	9.70	4.91	Between groups	1770.22	4	442.56	18.77	.00
	43-48	97	9.97	4.00	Within groups	14025.61	595	23.57		
	49-54	110	10.43	6.02	Total	15795.83	599			
	55-60	135	12.27	4.74						
	61-66	186	13.89	4.86						
	Total	600	11.71	5.13						
Compressive strength of fingers	36-42	72	2.08	1.28	Between groups	88.79	4	22.20	5.47	.00
	43-48	97	2.04	1.09	Within groups	2415.04	595	4.06		
	49-54	110	2.07	0.93	Total	2503.83	599			
	55-60	135	2.11	0.88						
	61-66	186	2.15	1.01						
	Total	600	2.10	1.04						

N=600

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